SOME FERTILIZER TESTS IN VINEYARDS.

SUMMARIZED BY
F. H. HALL

FROM BULLETIN BY
U. P. HEDRICK AND F. E. GLADWIN.

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In the Chautauqua Grape Belt the vineyard area increased fully one-third between 1900 and 1913, but the yield of grapes for the last half of this period was only 3½ per ct. greater than for the first half. In other words, while the area increased, the yields per acre decreased, so that many vineyards became a source of loss rather than gain to their owners. The very poor crop of 1908 called attention forcefully to the need for investigation into the cause, or causes, of the reduced yields, and an appropriation was secured from the State Legislature to support such work. In the spring of 1909 this Station leased a 30-acre farm near Fredonia on which there was already a large vineyard, and sent a corps of investigators into the field to learn, if possible, why these declines in yield had occurred.

A general survey of the situation made it clear than many vineyards had been planted on soils too thin, too infertile or too poorly drained to be suitable for grape culture; but many vineyards were noted, both old and young, on good soils but not producing profitable annual crops. Here something was evidently amiss, and it has been the object of the Station studies and tests to locate the unfavorable influences. Already much has been done to enable grape-growers to control certain insect pests that have, at times and over quite wide areas, seriously reduced crops; and directions for handling these foes have been given in Bulletins 331, 344, and 359 of the Station. In this bulletin there is presented a summary of five years' work in applying commercial fertilizers in order to insure an ample supply of plant food for the vines and the fruit they should bear.

A preliminary survey of conditions relative to the use of fertilizers in this district showed no uniformity of practice and no consistent gains from the many fertilizing materials and combinations used in different vineyards. The only conclusion that could be reached from this survey was "that growers who had used commercial fertilizers regularly, other conditions being the same, had secured less variable crops from year to year, than those who had made irregular and scant applications or none at all."

* This is a brief review of Bulletin No. 381 of this Station, on A Test of Commercial Fertilizers for Grapes, by U. P. Hedrick and F. E. Gladwin. Those specially interested in the detailed account of the investigations will be furnished, on application, with a copy of the complete bulletin. Names of those who so request will be placed on the Station mailing list to receive future bulletins as issued, popular or complete edition as desired.
Range and results of tests.

Five years' work with commercial fertilizers has now been completed in the leased vineyard at Fredonia; and from two to four years' work with similar fertilizers, and in some cases with manure and cover crops also, has been carried on in cooperation with the owners of six other vineyards in different parts of the Grape Belt. The results prove, mainly, that the problem of grape fertilizers is very dependent on other factors, and no very definite conclusions as regards specific applications have been reached through these comprehensive tests.

In the Fredonia vineyard, readily available nitrogen appears to be a determining factor in crop yields; but the other tests give no positive indications in the same direction. In these tests the duplicate plats in many instances give variant results; or the favorable influence of a fertilizer element in one combination will be offset by a loss or no gain when the same element is used in another combination. The conclusions which might be drawn from one vineyard are also quite liable to be at variance from those furnished by another vineyard under apparently comparable conditions.

Tests at Fredonia. In the vineyard at Fredonia eleven plats were laid out in a section of the vineyard where inequalities of soil and other conditions were slight or were neutralized. Each plat included three rows (about one-sixth of an acre) and was separated from the adjoining plats by a "buffer" row not under test. One plat in the center of the section served as a check, and five different fertilizer combinations were used on duplicate plats at either side of the check. Plats 1 and 7 received lime and a complete fertilizer with quick-acting and slow-acting nitrogen; Plats 2 and 8 received the complete fertilizer but no lime; on Plats 3 and 9 potash was omitted from the complete fertilizer combination; Plats 4 and 10 received no phosphorus; Plats 5 and 11, no nitrogen; and Plat 6 was the check. The materials were applied at such rates that they provided for the first year 72 pounds of nitrogen per acre, 25 pounds of phosphorus and 59 pounds of potassium; and for each of the last four years two-thirds as much nitrogen and phosphorus and eight-ninths as much potassium. The lime was applied the first and fourth years in quantity to make a ton to the acre annually. Cover crops were sown on all plats alike and were plowed under in late April or early May of each year. These differed in successive years, but included no legumes. The crops used were rye, wheat, barley and cowhorn turnips separately and the last two in combination.

The cultivation differed only in thoroughness from that generally used in the Belt, the aim being to maintain a good dust mulch during the whole growing season. Pruning by the Chautauqua System was done throughout by one man, who pruned solely according to the vigor of the individual vines and left four, two or three, or no fruiting canes as appeared best. The vineyard was thoroughly sprayed, all plats alike.
Low winter temperatures, affecting immature wood and buds caused by unfavorable weather of the previous season, reduced yields materially during two of the five years, and practically neutralized any anticipated benefit from fertilizers. Following the first of these low-crop years, came a season, 1911, in which favorable conditions, acting upon vines left undiminished in vigor by the light crop of the previous year, resulted in heavy and quite uniform yields on all the plats.

The yields for the five years are shown in Table I; and a summary showing the average gains from each treatment is given in Table II, with the average financial balance after deducting the cost of fertilizer application from the increased returns from the plats receiving them.

| Table I.—Yield of Grapes (Tons per Acre) in Fertilizer Experiments. |
|---|---|---|---|---|---|
| Plat. No. | 1909. | 1910. | 1911. | 1912. | 1913. | 5-year average. |
| Complete fertilizer; lime | 4.48 | 2.10 | 5.37 | 3.46 | 3.46 | 2.14 | 2.14 | 3.51 |
| Complete fertilizer | 4.76 | 2.21 | 5.71 | 4.30 | 4.30 | 2.83 | 2.83 | 3.96 |
| Nitrogen and phosphorus | 5.17 | 2.14 | 5.61 | 4.00 | 4.00 | 2.25 | 2.25 | 3.83 |
| Nitrogen and potash | 4.25 | 2.55 | 5.64 | 4.10 | 4.10 | 2.85 | 2.85 | 3.87 |
| Phosphorus and potash | 3.41 | 2.00 | 5.44 | 4.35 | 4.35 | 1.78 | 1.78 | 3.39 |
| Check | 3.38 | 2.10 | 5.32 | 3.60 | 3.60 | 1.24 | 1.24 | 3.12 |
| Complete fertilizer; lime | 4.69 | 2.38 | 5.62 | 4.80 | 4.80 | 3.04 | 3.04 | 4.10 |
| Complete fertilizer | 4.66 | 2.07 | 5.71 | 4.98 | 4.98 | 2.72 | 2.72 | 4.02 |
| Nitrogen and phosphorus | 4.99 | 2.04 | 5.35 | 4.89 | 4.89 | 2.61 | 2.61 | 3.97 |
| Nitrogen and potash | 4.79 | 2.26 | 5.91 | 4.89 | 4.89 | 3.07 | 3.07 | 4.18 |
| Phosphorus and potash | 4.99 | 1.87 | 5.03 | 4.21 | 4.21 | 1.97 | 1.97 | 3.61 |

| Table II.—Average Increase in Grape Yields and Average Financial Gain from Fertilizer Applications. |
|---|---|---|---|---|---|
| First plat of pair | 3.51 | 3.96 | 3.83 | 3.87 | 3.39 |
| Second plat of pair | 4.10 | 4.02 | 3.97 | 4.18 | 3.61 |
| Average | 3.80 | 3.97 | 3.90 | 4.02 | 3.50 |
| Check plat. | 3.12 | 3.12 | 3.12 | 3.12 | 3.12 |
| Average gain | .68 | .85 | .78 | .90 | .38 |
| Average financial gain | $5.82 | $13.84 | $14.05 | $18.54 | $6.99 |

From this last table the benefit from nitrogen appears quite evident since every combination in which it appears gives a substantial gain over the one from which it is absent. Phosphorus and potassium, without the nitrogen, lead to only a slight increase over the check;
and lime appears to be of no benefit. Financially, the complete fertilizer and lime combination, the nitrogen and phosphorus combination and the phosphorus and potassium combination failed to pay their cost in five of the ten comparisons; the complete fertilizer was used at a loss four times out of ten; and the nitrogen and potassium combination three times out of ten. Lime had no appreciable effect on either vines or fruit.

No effect of the fertilizers on the fruit itself, aside from yield, was shown for the first three years; but in 1912, and even more markedly in 1913, the fruit from the plats on which nitrogen had been used was superior in compactness of cluster, size of cluster and size of berry. In 1912 also, when early ripening was a decided advantage, the fruit on the nitrogen plats matured earlier than that on the check plats. In 1913 the favorable ripening season and the smaller crop tended to equalize the time of ripening on all plats. The grapes on the phosphorus-potassium plats were better in quality than those in the check plats but not as good as those on the plats where nitrogen was used.

Other indexes also show plainly the benefit from nitrogen in this vineyard; for size and weight of leaf, weight of wood produced and number of fruiting canes left on the vines were all greater where fertilizers, and particularly nitrogen, had been used. The three-year averages (1911–1913) of the measurements for these characteristics are shown in Table III.

<table>
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<tr>
<th>TABLE III.—Comparative Production of Leaves, Wood and Fruiting Canes on Grape Vines Differently Fertilized. (Averages for three years.)</th>
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<tr>
<td><strong>Fertilizer Application.</strong></td>
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<tr>
<td>Complete fertilizer; lime.</td>
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<td>Complete fertilizer.</td>
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<td>Nitrogen and phosphorus.</td>
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<td>Phosphorus and potassium.</td>
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<td>Check.</td>
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*Each weight is of 300 green leaves, 5 from each of 60 vines. The first leaf beyond the last cluster was selected.
† Amount per acre of wood pruned in fall.
‡ Number per acre.

In order to secure information as to the behavior of fertilizers on the different soils of the Grape Belt, cooperative experiments were carried on in six vineyards owned, respectively, by S. S. Grandin, Westfield; Hon. C. M. Hamilton, State Line; James Lee, Brocton; H. S. Miner,
Dunkirk; Miss Frances Jennings, Silver Creek; and J. T. Barnes, Prospect Station. The soil in these vineyards included gravelly loam, shale loam and clay loam, all in the Dunkirk series, and the experiments covered from two to two and a half acres in three cases and about five acres in each of the other vineyards. The work continued four years in all but one of the experiments, which it was necessary to end after the second year.

The general plan of the tests was much like that at Fredonia in most of the vineyards, with the additions of plats for stable manure and for leguminous and non-leguminous cover crops with and without lime. From two to six check plats were left for comparison in each vineyard. As already stated the results were often inconsistent in duplicate plats in the same vineyard, and if one test appeared to point definitely in a certain direction, the indication would be negatived by results in other vineyards. In these experiments the yield of fruit was the only index to the effect of treatments; as it was not possible to weigh leaves or pruned wood, or to count the canes left.

Nitrogen and potassium in combination, which gave the largest gains and greatest profit in the Station vineyard at Fredonia, showed a 13 per ct. increase in yield on one plat in the Jennings vineyard and a 9 per ct. decrease on the other; in the Miner vineyard this combination apparently resulted in a 25 per ct. increase, in the Lee vineyard in a 2½ per ct. loss; in the Hamilton vineyard a 17 per ct. gain; and in the Grandin vineyard neither gain nor loss. In only two of the five vineyards in which this combination was tested was the gain great enough to pay the cost of the fertilizer applied. Similar discrepancies, or absence of profitable gain, mark the use of the other fertilizer combinations.

Even stable manure, the standby of the farmer and fruit-grower, when applied at the rate of five tons per acre each spring, and plowed in, did not, on the average, pay for itself. Indeed, there were few instances among the 60 comparisons possible, in which more than a very moderate profit could be credited to manure. The average increase in yield following the application of manure alone was less than a quarter of a ton of grapes to the acre; while the use of lime with the manure increased the gain to one-third of a ton per acre. The ton of lime to the acre annually would not be paid for by the gain of 175 pounds of grapes. Cover crops were used in five of the six cooperative experiments; and proved even less adapted to increasing crop yields than did the manure. There was no appreciable gain, on the average, from the use of mammoth clover; indeed, a slight loss must be recorded for the clover except upon the plats which were also limed, and even with the lime the average yields on check plats and
mammoth clover plats differed by only one one-hundredth of a ton. Wheat or barley with cowhorn turnips made a slightly better showing, as the plats on which these crops were turned under, without lime, averaged about one-twentieth of a ton to the acre better than the checks. With these non-legumes, lime was apparently a detriment, as the plats with the lime yielded a tenth of a ton less, on the average, than those without it.

Suggestions from the results.

The results of the several tests of which this bulletin is an account throw comparatively little light on the value of fertilizers for grapes. It is evident that the fertilization of vineyards, as well as of orchards, fields and gardens, is so involved with other factors that only carefully planned and long continued work will give reliable results. Indeed, field experiments even in carefully selected vineyards, as the cooperative experiments show, may be so contradictory and misleading as to be worse than useless if deductions are made from the results of a few seasons. The work that has been done is not without value, however, for it has brought forth information about fertilizing vineyards that ought to be most helpful to grape-growers. Thus the results suggest:

First, and most important, that it is usually waste, pure and simple, to make applications of fertilizers in poorly-drained vineyards, in such as suffer frequently from winter cold or spring frosts, where insect pests are epidemic and uncontrolled, or where good care is lacking. The experiments furnish several examples of inertness, ineffectiveness, or failure to produce profit where the fertilizers were applied under any of the conditions named.

Second, it is certain in some of the experiments and strongly indicated in others that the soil is having a one-sided wear — that only one or a very few of the elements of fertility are lacking. The element most frequently lacking is nitrogen. The grape-grower should try to discover which of the fertilizing elements his soil lacks and not waste by using elements not needed.

Third, the marked unevenness of the soil in all of the seven vineyards in which these experiments were carried on, as indicated by the crops and the effects of the fertilizers, furnishes food for thought to grape-growers. Maximum profits cannot be approached in vineyards in which the soil is as uneven as in these, which were in every case selected because there was an appearance of uniformity. A problem before the grape-growers of Chautauqua county is to make more uniform all conditions in their vineyards.

Fourth, a grape-grower may assume that his vines do not need fertilizers if they are vigorous and making a fair annual growth. When the vineyard is found to be failing in vigor, the first step to be taken is to make sure that the drainage is good; the second step, to control insect and fungus pests; the third, to give tillage and good care; and the fourth step is to apply fertilizers if they are found necessary.